



## Theoretical Framework of Multimedia Learning

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### Abstract

*Multimedia learning has potential in education and improve the teaching learning process. The studies show that multimedia is based on theoretical framework. In this paper different theories which support the potential of multimedia learning and information processing system of human being have been described. This paper also includes various principles of multimedia teaching learning.*

**KEY WORDS:** Cognitive Theory, Short term memory, Cognitive Load Theory, Dual Coding, Coherence Principle

### Introduction:

The word ‘multimedia’ originally referred to the works of arts that combined multiple traditional art media, as in multimedia art installation. The term appeared in 1990s. The concept of multimedia has been described by educationists in different ways and different times. Multimedia, in general, means that information is presented in the form of audio, visual and animation in addition to traditional media to facilitate the learning. Studies conducted by Mayer (1992), Mayer and Anderson (1992), Krueger & Schor (2000) and Driscoll (2002), etc. have shown that students’ performance was enhanced by using multimedia instruction. All the studies also agree that multimedia presentation is based on theoretical understanding of how people learn from words and images.

### Theories of Multimedia Learning:

The important theories of multimedia learning are as under:

The cognitive theory of information focuses on how human memory system acquires, transfer, celebrate retrieves and uses information. According to this theory the memory is of three types-sensory, short term and long-term memory. The sensory memory receives the input through sight and sound and process it for three to five seconds. The information is hold until the stimulus is recognized or forgotten. Then this information is transformed to short term memory and remain active for 15-20 seconds without rehearsal and it is rehearsed celebrated and used for decision making or stored in long term memory before it is forgotten.

According to Muler (1950) “The short-term memory has room for about seven chunks of information, plus or minus two, depending upon the individual. Long term memory is an



unlimited and permanent storehouse of information. It receives information from sensory and short-term memory and stores it for longer time.”

Another theory which is concerned with multimedia learning is cognitive load theory. According to this theory, “When the learning material has high intrinsic load or high elements interactivity and these are presented as text, with other kind of visuals, it is better to present it aurally because the efficiency of information powering in working among will be enhanced if information is presented in different modalities (modality effect). When visuals are combined with text presented visually, learning is impaired because learners have to spilt their attention between text and visuals in order to integrate both sources of information (split attention effect).” These effects seem to be confirmed in studies conducted by Sweller, Mayer, Pass (1988), Kalyuga, Chandler and Sweller (1999), Mayer and Moreno (1998, 2002) etc. the advocates of cognitive load theory often refer to studies reviewed by Penncy (1989) and the working model proposed by Baddeley (2000) According to this model “Working memory consists of a control executive and at least three subsidiary systems : the phonological loop, the visual spatial sketchpad and episodic buffer. The central executive is an attention controller that supervise and coordinate the subsidiary system. The phonological loop had the function of processing speech or printed text whereas the visual spatial sketchpad is responsible for setting up and manipulating mental images. The episodic buffer is assumed to be the place where information from the subsystems of working memory and long term memory is integrated.”

The cue summation theory specifically deals with learning and retention in multimedia environment. According to this theory learning is increased by increasing of the available stimuli (Severian 1967). According to Severin, “Multiple channels communication appear to be superior to a signal channel communication when relevant cusses are summated across channels, rather is superior when redundant between channels, and are inferior when irrelevant cues are combined, in other words, stimuli provided should be relevant to each other or the distraction world cause a decrease rather that an increase in learning and retention.” Severing (1968) found that the combination of auditory signals with visual presentation, providing a different but related cue to the stimulus object, was more effective in producing recognition than a combination with visual presentation of the same cue a redundant condition.

Paivio and others’ theory of dual coding which explains that cognitive process occurs within two separate information processing systems. The visual system processes the visual knowledge while the verbal system is meant for processing of verbal knowledge. Both the verbal and non- verbal system are part of a symbolic system hierarchy which is orthogonally related to sensory motor system. Neale (1994) examined prediction of this theory by using multimedia package and found that although dual coded group performance was better than single coded group. The finding also shows that dual coded group spent more time in reviewing the content but less time in answering the questions.



According to Generative theory as propounded by Wittrock & others, “Learning occurs when learner select relevant information from the presentation, organization in to a coherent mental representation and integrated the new acquired knowledge with others.”

Mayer's (1997) explained the learning in multimedia environment through his cognitive theory which is based on the dual theory and generative theory. He considered the learner as knowledge constructor who actively select and connect the verbal and visual process of knowledge. The basic theme of this theory is that the design of multimedia instruction affects the degree to which learners engage in the cognitive process required for meaning learning within verbal and visual information process.

Mayer cognitive load model describe that human mind is limited in this capacity to attend, store and integrate information into level term memory (Mayer 2009) There are three basic assumptions of these cognitive theory:

- (i) humans have dual channel (visual and auditory)
- (ii) limited capacity to process information at one time by each channel
- (iii) active processing assumption which means selecting, organizing and integration of information.

In addition to cognitive assumptions, Mayer's model outlines five cognitive process necessary for meaningful multimedia learning

- (i) selecting relevant words from presented text for working verbal memory processing
- (ii) selecting relevant images for visual working memory
- (iii) organizing selected words into coherent verbal representation
- (iv) organizing selected images into content visual representation with preexisting knowledge.

If word or images disrupt any of these five cognitive processes, learning suffers due to incomplete representation of information; based upon this model Mayer has articulated different principles of designing multimedia instruction. These are

- (i) multimedia principle
- (ii) spatial contiguity principle.
- (iii) temporal contingently principle
- (iv) coherence principle
- (v) modality principle
- (vi) redundancy principle
- (vii) individual differences principle.

Researches have been conducted to explore what makes multimedia effective in teaching learning process. On the bases of researches conducted by different educationist, the important principles identified are as under:



### **Principles of Multimedia Teaching-Learning**

- 1) Multimedia learning is more effective when learner's attention is focused splitted:  
Multimedia application are more effective when the attention occurs when the learner is focused to attend to information that is far apart on the screen or if it is presented at two separate points in time.
- 2) Words and Pictures are better than words alone:  
The fundamental principle behind multimedia learning is described by Richard Mayer (2005) "People learn better from words and pictures than from words only". Researches show that use of both words and pictures lets the brain process more information in working memory. (Sweller 2008).
- 3) Principal of interaction and under the control of a learner:  
Every student has its pace of learning. The researches tell that learning is effective when the paces of presentation are under the control of learner. When the learner slows it down, speed fast and stop by interacting with it. Thus, multimedia can be used at own pace of learning by the user.
- 4) Principal of exclusion of extraneous and redundant information:  
The multimedia which has the relevant information in accordance with the objectives, content and educational needs of the learners are more effective. The multimedia which contains extraneous and redundant information disrupt the attention of the learner and learning is not effective.
- 5) Principal of activation of learner's knowledge structure prior to exposure to multimedia content:  
According to Pollock, Chandler and Sweller (2002) "the learning from multimedia presentation is enhanced when the structures for organizing the information are activated. Activation can be accomplished by allowing students to preview the content through demonstration, discussion, directed recall and written descriptions."
- 6) Multimedia instruction that includes animation improves learning:  
Animation helps the student to visualize a process or other dynamic phenomenon that cannot be visible easily. Animation makes the complex information easy and attention is more likely to be effective if it is accompanied by narration
- 7) Multimedia learning is more effective when learner is engaged with the presentation:  
Multimedia is more effective when the content and format actively engage the learner. Active engagement helps the students to construct knowledge and organize information into meaningful schema. Multimedia that is more personalized engages learners more than multimedia that are less personalized (Mayer, 2005).
- 8) Multimedia learning is more effective when learner apply their newly acquired knowledge and receive feedback:  
Multimedia is more effective when students get opportunities to apply what they have learned. This reinforces and strengthen the newly acquired knowledge. Feedback helps the students informing to know about their progress. Feedback reinforce what has been



learned and can correct misconceptions. Feedback is most effective when it is frequent and immediate.

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